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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
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| 10/807,235 | 03/24/2004 | Akira Sakai | 119232 | 4501 |

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OLIFF & BERRIDGE, PLC
P.O. BOX 19928
ALEXANDRIA, VA 22320

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| EXAMINER |
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PERT, EVAN T

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| ART UNIT | PAPER NUMBER |
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2829

DATE MAILED: 09/22/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

AK

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|------------------------------|------------------------|---------------------|--|
| Office Action Summary | Application No. | Applicant(s) | |
| | 10/807,235 | SAKAI ET AL. | |
| | Examiner | Art Unit | |
| | Evan Pert | 2829 | |

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 24 March 2004.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-19 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-19 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 24 March 2004 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
 Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
 Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☒ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|---|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Priority

1. Applicant's claim for priority under 35 USC 119(e) is acknowledged. However, as of this writing, priority documents have not been scanned into the electronic record (i.e. e-Dan), and were therefore unavailable for review.

Oath/Declaration

2. The Oath/Declaration was not scanned into the electronic record (i.e. e-Dan), and was therefore not available for review.

Specification

3. Technically speaking, the specification includes improper grammar; although understandable, the improper English grammar is likely a result of translation from Japanese into English.

For example, at page 1, grammatical informalities are related to "...and interface characteristic..." at line 8 and "...reaches the limit..." at line 12. Informalities of this type exist throughout the specification.

While applicant may choose any style of writing, the style should be grammatically correct in English.

Besides the grammatical informalities, the specification is objected to for typographical errors at p. 6, lines 7, 9, 11, 14, 15 and 16, wherein " P₂O₃ " should read -- Pr₂O₃ —(i.e. Praseodymium Oxide).

Applicant is requested to provide a corrected substitute specification.

Claim Rejections - 35 USC § 112

4. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 12-19 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claims 12 through 19 are known as "product-by-process" claims [MPEP 2113].

Normally, an applicant may claim a product by reciting process limitations "so long as the process limitations are clearly directed to the product" [MPEP 2173.05(p)].

In the instant case, the recited process limitations are not clearly directed to the *product*, because the *process* limitations recite growth and *thermal treatment*, rather than observable characteristics of the oxide that set the oxide apart from prior art.

Applicant's claimed "metallic oxide film of high dielectric constant" among claims 12-19 is an oxide film that may be amorphous or crystalline [0007], and has un-named "constituents" that are referred to as "some impurities" [0012], even though the necessary "constituents" of a silicon wafer substrate are presumably Si atoms.

Furthermore, the claimed oxide supposedly has "no interface layer" [e.g. claim 11], yet Fig. 3 clearly shows a thin layer where Pr_2O_3 and Si meet, which is reasonably an "interface layer" such as the same kind of interface layer in Fig. 2 of Osten et al., that is "no interface layer," when compared on the same 5 nm scale as applicant's Fig. 3.

Claim Rejections - 35 USC § 102

5. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1-7 and 9-19 are rejected under 35 U.S.C. 102(b) as being anticipated by Osten et al. (2000 IEEE article entitled High-k Dielectrics with Ultra-low Leakage Current Based on Praseodymium Oxide).

Regarding claims 1 and 12, Osten et al. disclose fabrication of a metallic oxide film of high dielectric constant (i.e. Praseodymium Oxide with a dielectric constant of 31), comprising the steps of: epitaxially growing a given metallic oxide film on a substrate (the "given" film being Praseodymium Oxide, epitaxially grown by MBE), and thermally treating the substrate and the given metallic oxide film with anneals of up to 1000°C for 15 seconds (which necessarily meets the limitation drawn to "mixing constituent elements of the substrate" with "constituent elements of the given metallic oxide film" because the thermal treatment at 1000°C disclosed by Osten et al. is such that the "mixing of the constituent elements can easily be performed" per [0016]).

Regarding claims 2 and 15, the substrate is silicon (Fig. 2).

Regarding claims 3 and 16, the given metallic oxide film is Pr₂O₃ (i.e. Praseodymium Oxide)

Regarding claim 4, the temperature is performed at 1000°C [abstract].

Regarding claims 5-7, "a short furnace anneal in nitrogen" at the section entitled "Electrical Characterization" is known by the ordinary of skill in the art as an anneal in a "non-oxidizing atmosphere" at "atmospheric pressure" (because a "furnace anneal" implies atmospheric pressure while a "vacuum anneal" or anneal "under pressure" would be explained by Osten et al., for other than atmospheric pressure).

Regarding claims 9 and 14, Osten et al. discloses that the film of P_2O_3 is best "amorphous" in order to "avoid increased surface roughness and grain boundary induced leakage current" [e.g. Introduction].

Regarding claims 10 and 17, the dielectric constant is reported as "31" [abstract].

Regarding claims 11 and 13, there is "no interface layer" (just an interface), as seen comparing applicant's Fig. 3 to Fig. 2 of Osten et al., with the scale of both being 5 nm.

Regarding claim 18 and 19, the title of Osten et al. that recites "High-K Gate Dielectric..." conveys to anyone of rudimentary skill in the art that the article is about a metallic oxide gate insulating film of high dielectric constant, a gate insulating film necessarily being part of a "semiconductor element" (i.e. a transistor's gate oxide).

Claim Rejections - 35 USC § 103

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claim 8 is rejected under 35 U.S.C. 103(a) as being unpatentable over Osten et al. as applied to claim 4 above.

Osten et al. is silent about the rate at which the "substrate" with "given metallic oxide film" is heated to 1000°C, but does indicate "1000°C/15s RTA," which conveys to the ordinary of skill that a Rapid Thermal Anneal is conducted for 15 seconds.

It would have been obvious to heat to 1000°C at a rate of 50-100°C per second, motivated to perform a Rapid Thermal Anneal as quickly as possible, but not so rapid so as to cause undue thermal stress [MPEP 2144].

Conclusion

7. The prior art made of record and not relied upon is considered pertinent to applicant's claimed "metallic oxide film of high dielectric constant":

- T. Kanashima et al., "Preparation by Pulsed Deposition and Characterization of ZrO₂, HfO₂ and PrO_x Thin Films for High-k gate Insulator" (IEEE 2002)
- H.J. Osten et al., "Epitaxial Praseodymium Oxide: A New High-k Dielectric" (IWGI 2001)
- H.J. Mussig et al., "Can Praseodymium Oxide be an Alternative High-k Gate Dielectric Material for Silicon Integrated Circuits?" (IEEE 2001)

8. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Evan Pert whose telephone number is 571-272-1969. The examiner can normally be reached on M-F (7:30AM-3:30 PM).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Michael Tokar can be reached on 571-272-1812. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

ETP
September 16, 2004


EVAN PERT
PRIMARY EXAMINER